CHAPTER 12
RIGGING ACCESSORIES

This chapter provides requirements for rigging accessories used in hoisting and rigging—shackles, eyebolts, rings, wire-rope clips, turnbuckles, rigging hooks, and load-indicating devices.

12.1 GENERAL

a. The information presented in this chapter provides guidance for safely handling lifted loads. Diagrams are used to illustrate hoisting and rigging principles and good and bad rigging practices. This is not a rigging textbook; the information should be applied only by qualified riggers.

b. Rigging accessories that have been damaged or removed from service shall be made unusable for hoisting and rigging operations before being discarded.

c. Load tables are representative only and are not exact for all materials or all manufacturers.

d. Determine the weight of the load:

1. From markings on the load.

2. By weighing, if the load is still on the truck or railroad car.

3. From drawings or other documentation.

4. By calculation, using the load dimensions and the weights of common materials in Table 12-1.

e. Determine the center of gravity of the load as accurately as possible:

1. From drawings or other documentation.

2. From markings on the load.

3. By calculation.

f. Determine the best method to attach the load and select the lifting devices (e.g., eyebolts or shackles).

12.1.1 Inspections

a. The operator or other designated person shall visually inspect rigging accessories at the beginning of each work shift or prior to use for the following (records not required):

1. Wear.

2. Corrosion.

3. Cracks.

4. Nicks and gouges.

5. Distortion such as bending or twisting.

6. Evidence of heat damage from any cause.

b. A designated person shall determine whether conditions found during the inspection constitute a hazard and whether a more detailed inspection is required.

c. Rigging accessories having any of the following conditions shall be removed from service:

1. Cracks.

2. Distortion or deformation exceeding 15 percent of new conditions.

3. Any sign of incipient failure in shear for shackle pins.

4. Wear exceeding 10 percent of original dimensions.

5. Excessive corrosion.

6. Shackles not marked according to Section 12.3, “Shackles.”

7. Heat damage.

D. A designated person shall perform nondestructive examinations according to applicable ASTM standards when needed by the responsible line manager or that person's authorized representative.

e. A sample load test and inspection form is included as Exhibit I at the end of this chapter. This form is a sample only and is not intended to be mandatory.

Table 12-1. Weights of common materials.

Name of metal	Weight (lb/ft^3)	Name of material	Weight (lb/ft^3)
Aluminum	166	Bluestone	160
Antimony	418	Brick, pressed	150
Bismuth	613	Brick, common	125
Brass, cast	504	Cement, Portland (packed)	100–120
Brass, rolled	523	Cement, Portland (loose)	70–90
Copper, cast	550	Cement, slag (packed)	80–100
Copper, rolled	555	Cement, slag (loose)	55–75
Gold, 24-carat	1,204	Chalk	156
Iron, cast	450	Charcoal	15–34
Iron, wrought	480	Cinder concrete	110
Lead, commercial	712	Clay, ordinary	120–150
Mercury, 60 degrees F	846	Coal, hard, solid	93.5
Silver	655	Coal, hard, broken	54
Steel	490	Coal, soft, solid	84
Tin, cast	458	Coal, soft, broken	54
Uranium	1,163	Coke, loose	23–32
Zinc	437	Concrete or stone	140–155
		Earth, rammed	90–100
Name of wood		Granite	165–170
		Gravel	117–125
Ash	35	Lime, quick (ground loose)	53
Beech	37	Limestone	170
Birch	40	Marble	164
Cedar	22	Plaster of paris (cast)	80
Cherry	30	Sand	90–106
Chestnut	26	Sandstone	151
Cork	15	Shale	162
Cypress	27	Slate	160–180
Ebony	71	Terra-cotta	110
Elm	30	Traprock	170
Fir, Balsam	22	Water	65
Hemlock	31		
Maple, Oak	62		
Pine, Poplar	30		

12.1.2 Testing

a. Multileg lift assemblies shall be proof-tested based on any two legs sharing the entire load. Attach legs not undergoing test in a manner to ensure that load stability is not lost during the test.

b. Dynamometers and load cells shall be calibrated at least once a year and when specified in the critical lift procedure before being used to make a critical lift. This also applies if they have not been used in the previous 6 months. All calibrated devices shall have a tag affixed indicating date of calibration, by whom they were calibrated, and the date that the next calibration is due.

12.1.3 Good and Bad Rigging Practices

Figure 12-1 illustrates some good and bad rigging practices.

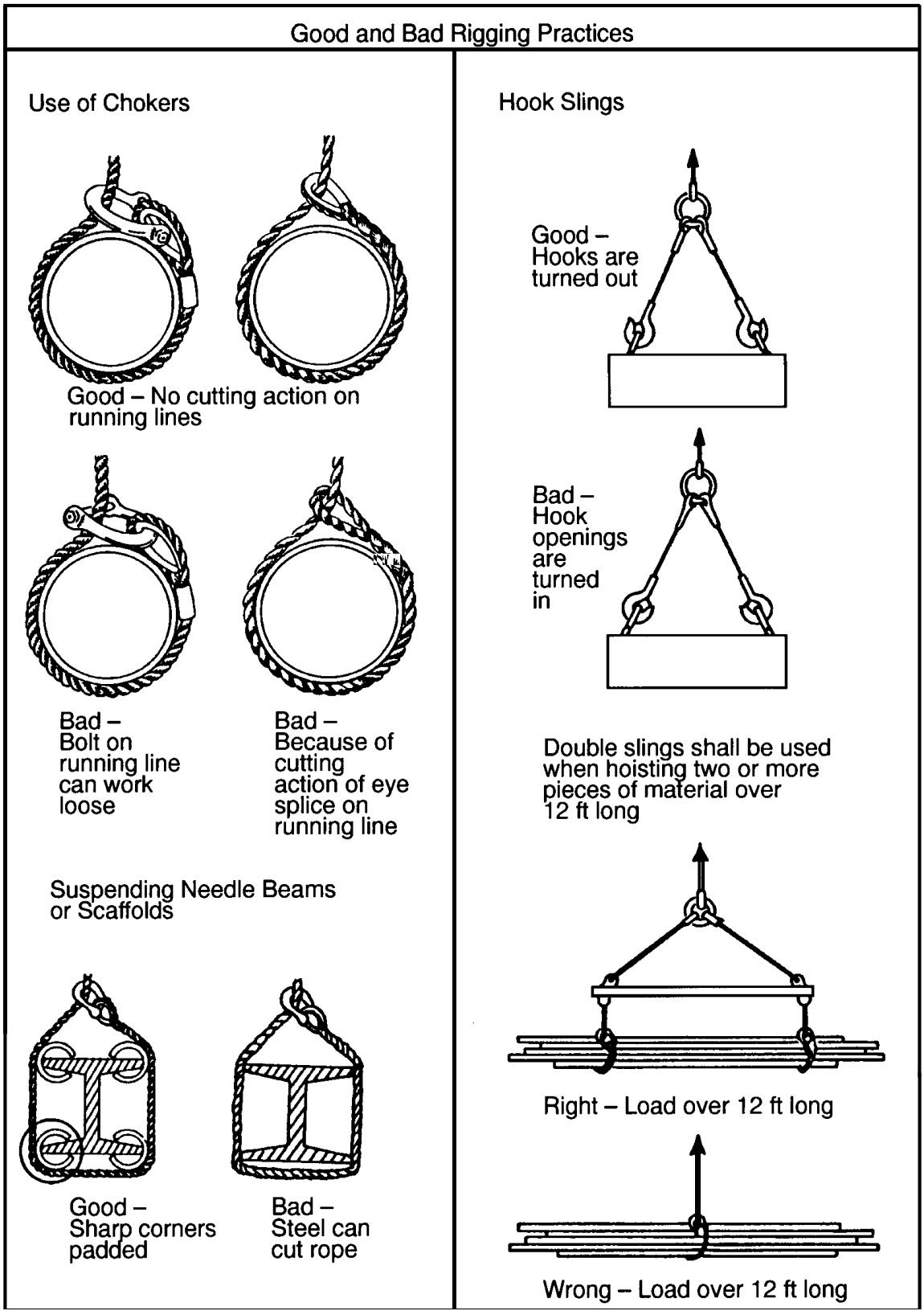
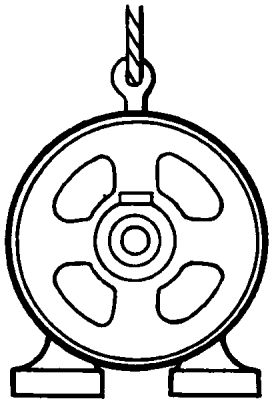


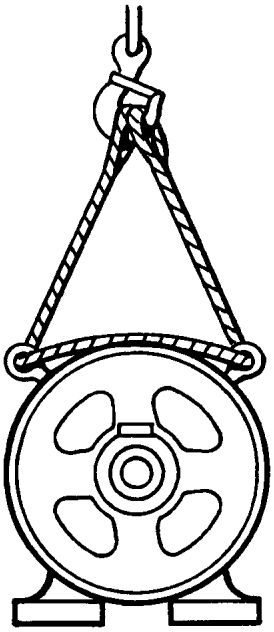
Figure 12-1. Good and bad rigging practices.

Good and Bad Rigging Practices

Eyebolts

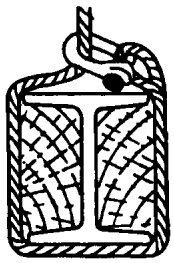


Good practice—vertical lift on eyebolt

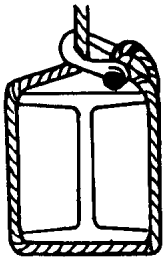


Bad practice – lifting on eye-bolts from an angle reduces safe loads as much as 90%

Hoisting Structural Steel



Good – Use space blocks and pad corners



Bad – Can bend flanges and cut rope

Eye Splices

Good practice – Note use of thimble in eye splice

Good practice – Use of thimble in eye splice

Bad practice – Wire rope knot with clip. Efficiency 50% or less

Bad practice – Thimble should be used to increase strength of eye and reduce wear on rope

Figure 12-1. (continued).

12.2 RIGGING HOOKS

12.2.1 Design

a. Hook design shall meet generally accepted hook design standards and be compatible with the requirements of ASME B30.10, Chapter 10-2, "Hook—Miscellaneous" (see Chapter 13, "Load Hooks," for equipment load hook requirements.)

b. Latch-equipped hooks shall be used unless the application makes the use of the latch impractical or unnecessary.

12.2.2 Marking

The manufacturer's identification shall be forged, cast, or die-stamped on a low-stress and nonwearing area of the hook.

12.2.3 Construction

a. The hook material shall have sufficient ductility to permanently deform before failure at the temperature at which the hook will be used.

b. Rated capacities for hooks shall equal or exceed the rated capacity of the chain, wire rope, or other suspension members to which they are attached.

12.2.4 Load Limits

A hook shall not be loaded beyond its rated capacity, except as is necessary to conform to the requirements for load testing of the sling or hardware to which it is attached. See Table 12-2 for hook capacity.

12.2.5 Inspections

12.2.5.1 Initial Inspection

a. A qualified inspector shall inspect all new and repaired hooks prior to initial use to ensure compliance with the applicable provisions of ASME B30.10 Section 10-2.2. Dated and signed inspection records shall be kept on file and shall be readily available.

b. Inspection procedure and record keeping requirements for hooks in regular service shall be determined by the kind of equipment in which they are used. When such requirements for hooks are stated in standards for the specific equipment, they shall take precedence over the requirements of this section.

12.2.5.2 Daily Inspection

a. The operator or other designated person shall visually inspect hooks daily or prior to first use, if the hook is not in regular service, for the following (records are not required):

1. Cracks, nicks, gouges.

2. Deformation.

3. Damage from chemicals.

4. Damage, engagement, or malfunction of latch (if provided).

5. Evidence of heat damage.

b. A designated person shall examine deficiencies and determine whether they constitute a safety hazard and whether a more detailed inspection is required.

12.2.5.3 Frequent Inspection

a. The operator or other designated personnel shall visually inspect the hook at the following intervals (records are not required):

1. Normal service—monthly.

2. Heavy service—weekly to monthly.

3. Severe service—daily to weekly.

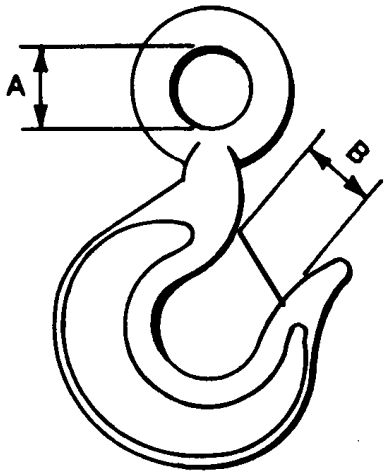
b. Hook service is defined as follows:

1. Normal service—operation at less than 85 percent of rated capacity except for isolated instances.

2. Heavy service—operation at 85 to 100 percent of rated capacity as a regular specified procedure.

3. Severe service—operation at heavy service coupled with abnormal operating conditions.

Table 12-2. Strength of standard sling hooks.



Standard hook number	Inside diameter of Eye A (in.)	Throat Opening B (in.)	Rated capacity (tons)
22	3/4	1	0.5
23	7/8	1 1/16	0.6
24	1	1 1/8	0.7
25	1 1/8	1 1/4	1.2
26	1 1/4	1 3/8	1.7
27	1 3/8	1 ½	2.1
28	1 ½	1 3/4	2.5
29	1 5/8	1 7/8	3.0
30	1 3/4	2 1/16	4.0
31	2	2 1/4	4.7
32	2 3/8	2 ½	5.5
33	2 3/4	3	6.8
34	3 1/8	3 3/8	8.0
34[a]	3 1/4	3 5/8	10.0
35	3 ½	4	11.0
36	4	4 ½	20.0
38	4 ½	5	30.0

Notes:

a. The above values are for “Vulcan” and similarly designed standard hooks.

b. The capacity can be found by the diameter of the hole in the eye of the hook. If the throat opening of any hook exceeds the dimension given above the corresponding diameter of the eye, the hook has been over strained and must not be used.

c. These inspections shall, in addition to the requirements of Section 12.2.5.2, "Daily Inspections," include the following:

1. Wear.

2. Hook attachment and securing means.

d. A designated person shall examine deficiencies and determine whether a more detailed inspection is required.

12.2.5.4 Periodic Inspection

a. A qualified inspector shall perform a complete inspection at the following intervals:

1. Normal service—yearly.

2. Heavy service—semiannually.

3. Severe service—quarterly.

b. A qualified inspector shall examine deficiencies and determine whether they constitute a safety hazard.

c. The inspection shall include the requirements of Section 12.2.5.3, "Frequent Inspection."

d. Hooks having any of the following conditions shall be removed from service until repaired or replaced:

1. Deformation—Any bending or twisting exceeding 10 degrees (or as recommended by the manufacturer) from the plane of the unbent hook.

2. Throat opening—Any distortion causing an increase in throat opening exceeding 15 percent (or as recommended by the manufacturer).

3. Wear—Any wear exceeding 10 percent (or as recommended by the manufacturer) of the original section dimension of the hook or its load pin.

4. Cracks.

e. If a latch is provided and it becomes inoperative because of wear or deformation or fails to fully bridge the throat opening, the hook shall be removed from service until the device has been repaired or replaced and the throat opening has been determined not to exceed 15 percent (or as recommended by the manufacturer).

f. Dated and signed inspection records shall be kept on file and shall be readily available.

12.2.6 Testing

a. Hooks not attached to slings or other lifting hardware shall be proof tested to 200 percent of the rated capacity prior to initial use. The test load shall be accurate to within -5 percent, +0 percent of stipulated values.

b. For critical lifts, if proof testing cannot be verified, the hook(s) shall be proof tested before being used to make critical lifts.

c. No performance testing of hooks shall be required, except as is necessary to conform to the requirements for the slings or rigging hardware of which they are a part.

d. If detailed inspections are performed (refer to Sections 12.2.5.2.b, 12.2.5.3.d, and 12.2.5.4.c), the results shall be evaluated by a qualified person to determine the need for subsequent nondestructive testing (NDT). If NDT is deemed necessary, it shall be performed in accordance with Section 13.4.3.

12.2.7 Maintenance

a. A designated person shall repair cracks, nicks, and gouges by grinding longitudinally, following the contour of the hook, provided that no dimension is reduced more than 10 percent of its original value (or as recommended by the manufacturer).

b. All other repairs shall be performed by the manufacturer.

12.2.8 Operation

The following shall apply to rigging hook users:

a. Determine that the load or force required does not exceed the rated capacity of the hook's assembly, especially when considering special conditions such as choking or grabbing.

b. Avoid shock loading.

c. Keep hands, fingers, and body from getting between the hook and the load.

12.3 SHACKLES

12.3.1 General

a. Shackles are made of drop-forged steel bent into shape. They are strong, closed attachments that will not come unhooked. The size is specified by the diameter of the body. Avoid side pulls on the shackle body.

b. Shackle pins should fit free without binding. Do not substitute a bolt for the shackle pin. Figure 12-2 shows shackles and provides examples of good and bad practices and inspection points.

c. Each shackle body shall be permanently and legibly marked by the manufacturer. Raised or stamped letters on the side of the bow shall be used to show:

1. Manufacturer's name or trademark.

2. Size.

3. Rated capacity.

d. Shackles that are not properly marked shall be permanently removed from service.

e. When shackles are used at load angles other than 90 degrees , the safe-load rating shall be reduced accordingly.

12.3.2 Critical Lifts

See Chapter 2, “Critical Lifts,” for critical lift requirements.

a. Shackles used for critical-lift service shall have an initial proof load test of 200 percent of the rated capacity. Test weights shall be accurate to within -5 percent, +0 percent of stipulated values. If proof testing cannot be verified, the shackle(s) shall be proof tested before being used to make a critical lift.

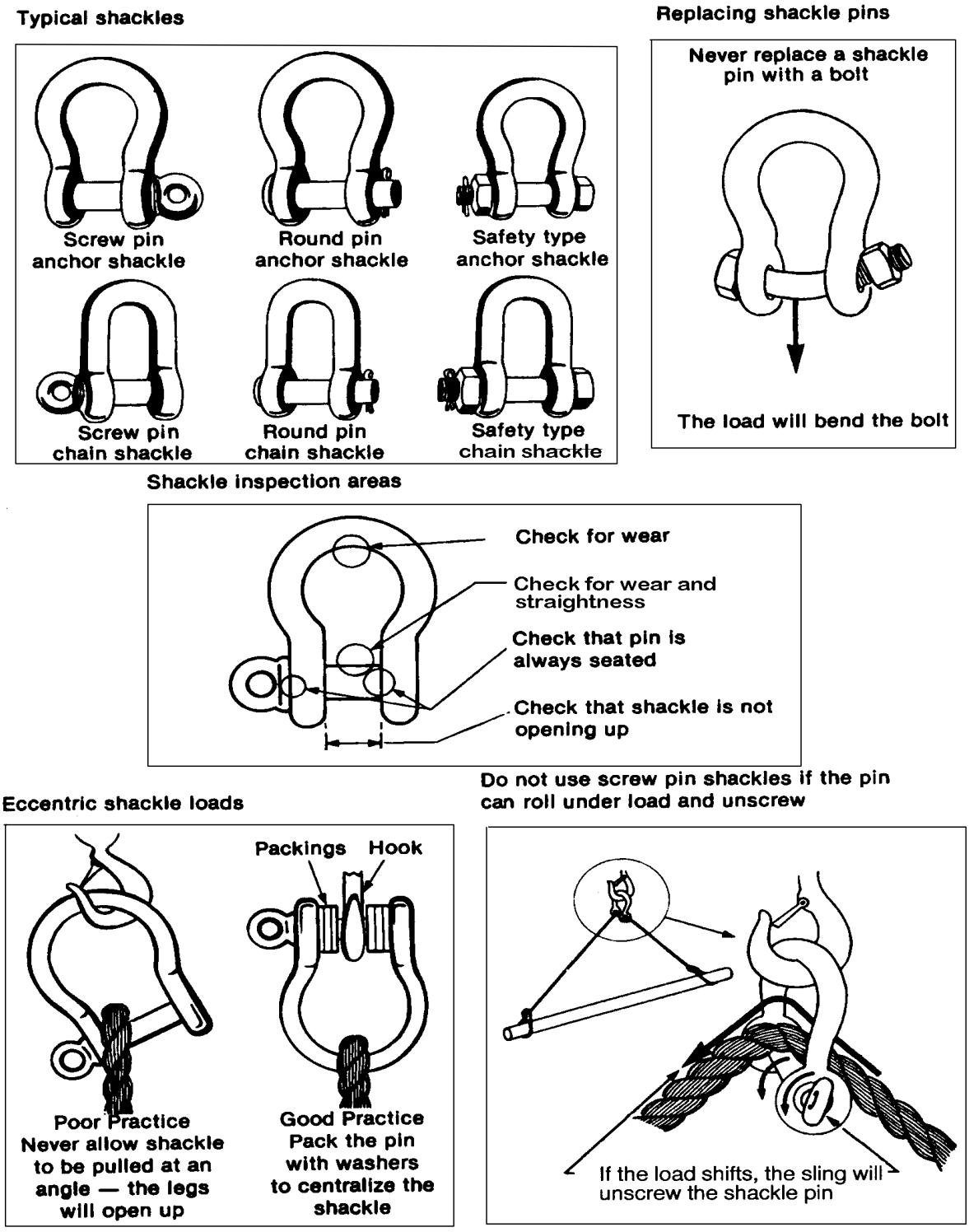


Figure 12-2. Shackles.

12.4 EYEBOLTS

12.4.1 General

a. This section specifies requirements for eyebolts that are used as rigging hardware during normal hoisting and rigging activities. Eyebolts designed for and permanently installed on existing engineered equipment are considered part of the engineered equipment, and they may not meet all requirements specified for rigging hardware. Eyebolts permanently installed on engineered equipment are acceptable for their intended use so long as they pass normal visual inspection before use. It is important to know how the manufacturer or engineered equipment intends permanently installed eyebolts to be used. In some cases the intended use is obvious to an experienced craftsman in other cases engineering review of vendor information may be necessary.

CAUTION: Eyebolts installed by the manufacturer to lift only parts of the engineered equipment are not suitable for lifting the completed piece of equipment. When questions arise regarding the use of manufactured-installed eyebolts, the equipment custodian or cognizant engineer shall be consulted.

b. Eyebolts used for hoisting shall be fabricated from forged carbon or alloy steel.

c. Eyebolt marking:

1. Carbon Steel Eyebolts shall have the manufacturer's name or identification trademark forged in raised characters on the surface of the eyebolt.

2. Alloy Steel Eyebolts shall have the symbol "A" (denoting alloy steel) and the manufacturer's name or identification mark forged in raised characters on the surface of the eyebolt.

d. Eyebolts shall have a minimum design factor of 5:1.

e. Eyebolts shall have Class II fit and have a minimum of one-and-one-half diameters thread engagement. Nuts on through-eyebolts shall be self-locking or shall be secured with lock wires or other suitable means to prevent loosening.

f. The following shall apply to eyebolt users:

1. Use shouldered eyebolts for all applications, except where it is not possible due to the configuration of the item to be lifted. See Figure 12-3. When unshouldered eyebolts are used, do not use nuts, washers, and drilled plates to make shouldered eyebolts.

2. Do not use wire-type or welded eyebolts in DOE-lifting operations.

3. Ensure shoulders seat snugly against the surface on which they bear.

4. Spacers may be used, if necessary, to ensure proper seating of the eyebolt. Use a flat spacer no thicker than 1/16 of the outside diameter and approximately the same diameter as the maximum axis of the eyebolt shoulder with the smallest inside diameter that will fit the eyebolt shank.

5. Spot-face or slightly counterbore the surface of the item to which the eyebolt is fastened to the minimum depth needed for cleanup of the surface and complete bearing of the shoulder or spacer on the bearing surface.

6. Carefully inspect each eyebolt before use. Visually inspect the hole to ensure that there has been no deformation. Check the condition of the threads in the hole to ensure that the eyebolt will secure and the shoulder can be brought down snug. Destroy eyebolts that are cracked, bent, or have damaged threads.

7. Ensure that the shank of the eyebolt is not undercut and is smoothly radiused into the plane of the shoulder or the contour of the ring for nonshouldered eyebolts.

8. When more than one eyebolt is used in conjunction with multiple-leg rigging, spreader bars, lifting yokes, or lifting beams should be used to eliminate angular lifting. However, where spreaders, yokes, or beams cannot be used, eyebolts may be used for angular lifting, provided that the limiting conditions in Table 12-3 are considered. An angular lift is any lift in which the lifting force is applied at any angle to the centerline of the shank of the eyebolt.

9. Where nonshouldered eyebolts must be used for a critical lift, ensure that an engineering analysis of the loading and load vectors is made and approved before use. Minimize the angle between the sling and the

eyebolt axis. In no case shall the eyebolt loading exceed the values shown in Table 12-3.

12.4.2 Critical Lifts

See Chapter 2, "Critical Lifts," for critical lift requirements.

a. Eyebolts used for critical-lift service shall have an initial proof load test of 200 percent of the rated capacity. Test weights shall be accurate to within -5 percent, +0 percent of stipulated values. If proof testing cannot be verified, the Eyebolts shall be proof tested before being used to make a critical lift.

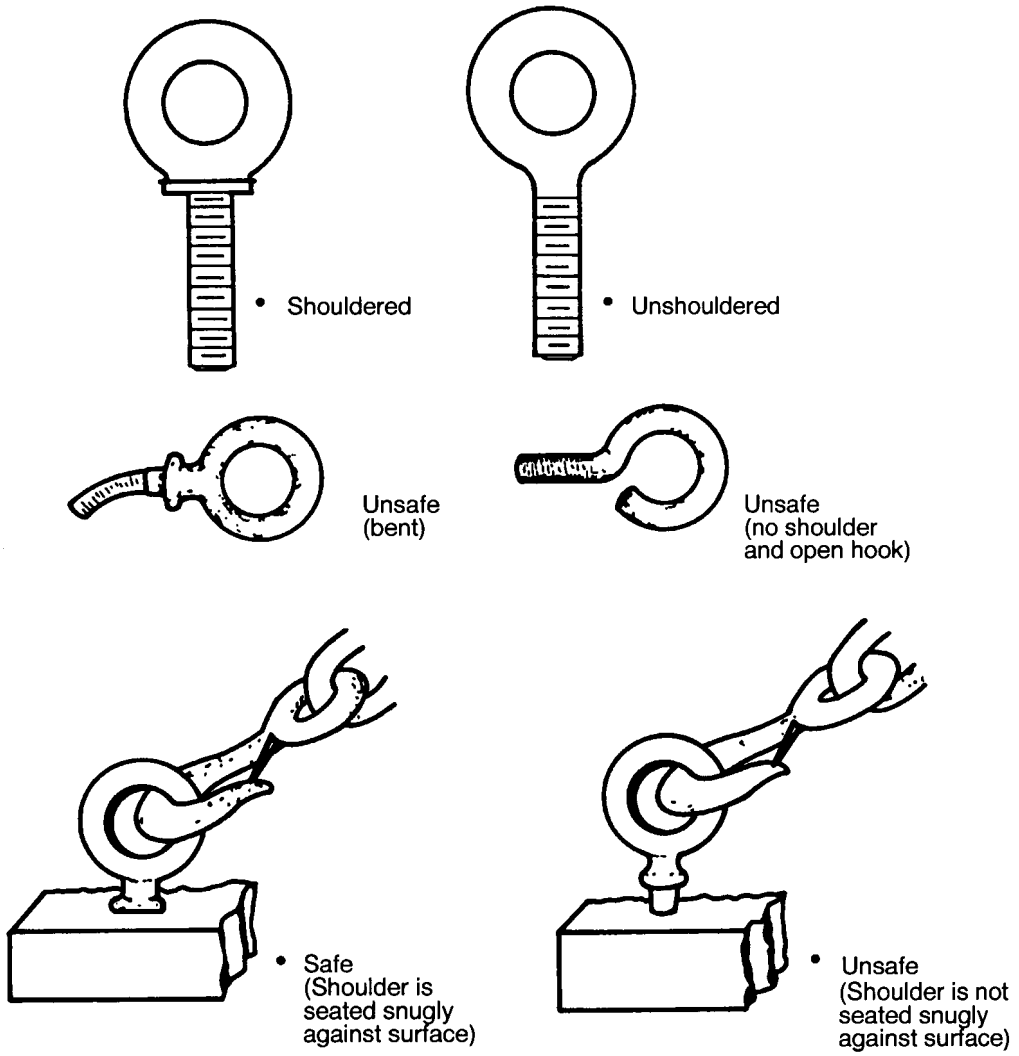
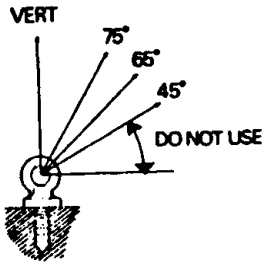


Figure 12-3. Eyebolts.

Table 12-3. Safe loading of eyebolts.

EYEBOLTS
— Shoulder Type Only
— Forged Carbon Steel



Stock diameter (in.)	SAFE WORKING LOADS CORRESPONDING TO ANGLE OF PULL				
	Vertical	75 degrees	60 degrees	45 degrees	Less than 45 degrees
1/4 5/16 3/8 ½ 5/8 3/4 7/8 1 1 1/4 1 ½	500 800 1,200 2.200 3,500 5,200 7,200 10,000 15,200 21,400	Reduce vertical loads by 45%	Reduce vertical loads by 65%	Reduce vertical loads by 75%	NOT RECOMMENDED

Note: The safe working loads for plain (shoulder less) eyebolts is the same as for shoulder bolts under vertical load. Angular loading is not recommended.

12.5 TURNBUCKLES

12.5.1 General

a. Turnbuckles may be used in sling systems provided that they are engineered, designed, and approved as a part of the sling system. Approved turnbuckles shall be marked and identified for use with the sling set for which they were designed and shall be load-tested as part of the sling set. Before each use, turnbuckles shall be inspected for damage. Damaged threads, jamb nuts, or bent frame members make the unit unsuitable for use.

b. Jamb nuts or locking devices must be tightened or locked before making lifts withturnbuckles. See Figure 12-4 for safe working load information and turnbuckle inspection areas.

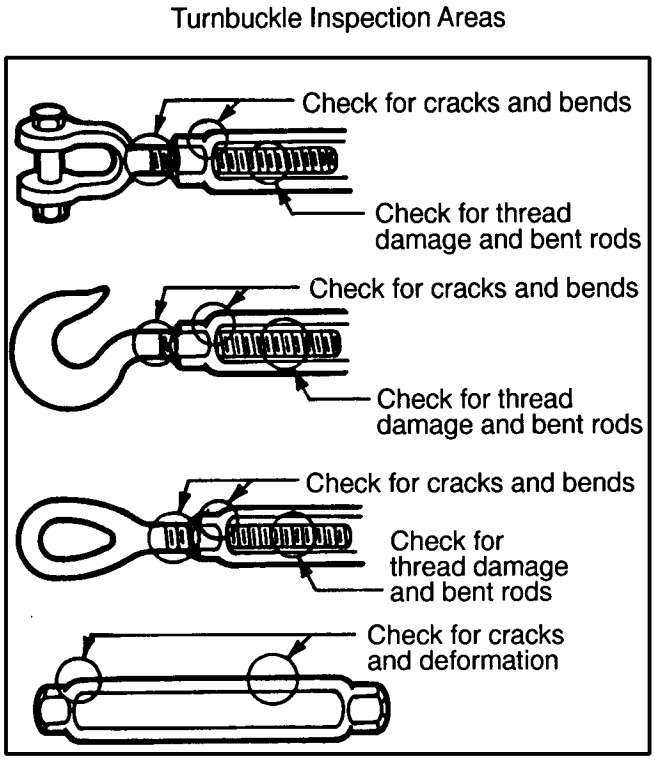
c. Turnbuckles shall be fabricated from forged alloy steel and shall have a minimum design factor of 5:1.

d. Turnbuckles used in applications where there is vibration shall be secured to the frame with locks, pins, or wires to prevent turning or loosening.

12.5.2 Critical Lifts

See Chapter 2, “Critical Lifts,” for critical lift requirements.

a. Turnbuckles used for critical-lift service shall have an initial proof load test of 200 percent of the rated capacity. Test weights shall be accurate to within -5 percent, +0 percent of stipulated values. If proof testing cannot be verified, the turnbuckles shall be proof tested before being used to make a critical lift.



Turnbuckles

- Weldless Construction
- Forged Alloy Steel

End fitting, stock diameter (in.)	Safe working load (SWL) of any combination of jaw end fittings, eye end fittings, and stub end fittings (lb)	SWL of any turnbuckle having a hook end fitting (lb)
1/4	500	400
5/16	800	700
3/8	1,200	1,000
1/2	2,200	1,500
5/8	3,500	2,250
3/4	5,200	3.000
7/8	7,200	4,000
1	10,000	5,000
1 1/4	15,200	5,000
1 1/2	21,400	7,500
1 3/4	28,000	—
3	37,000	—
2 1/2	60,000	—
2 3/4	75,000	—

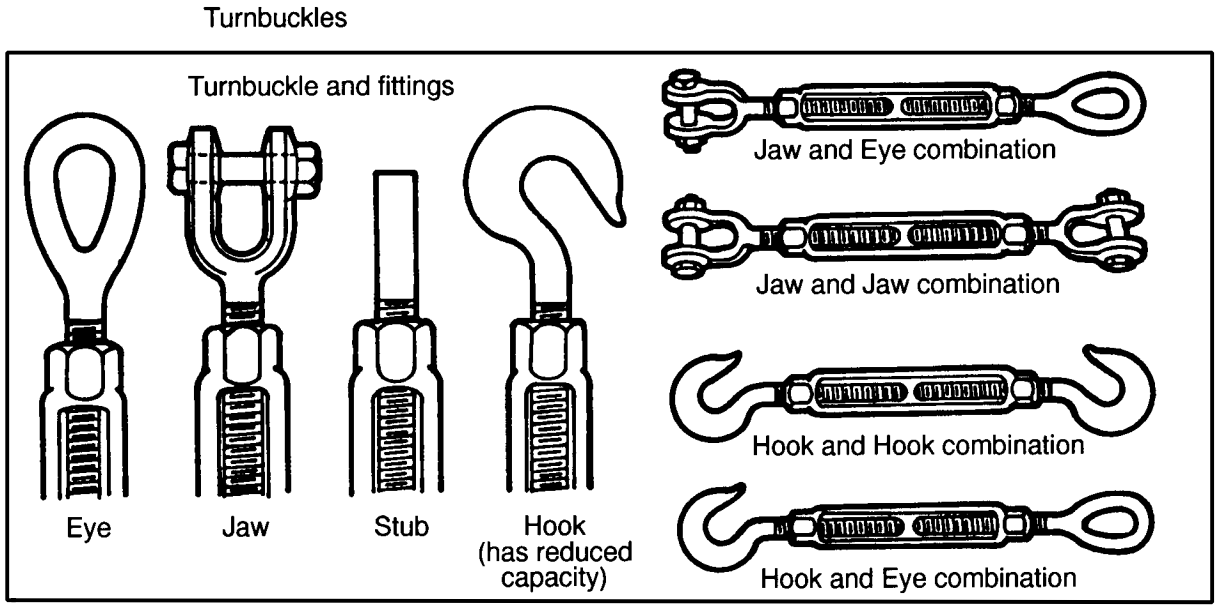


Figure 12-4. Turnbuckles.

12.6 LINKS AND RINGS

12.6.1 General

a. Links and rings are usually designed and manufactured as a part of the lifting hardware for a specific purpose, such as the peak link on multiple-leg slings. However, the rings and links may also be found on the load-attachment end of slings. Figure 12-5 shows typical rings and links. Table 12-4 provides safe loads for weldless rings and links.

12.6.2 Critical Lifts

See Chapter 2, "Critical Lifts," for critical lift requirements.

a. Links and rings used for critical-lift service shall have an initial proof load test of 200 percent of the rated capacity. Test weights shall be accurate to within -5 percent, +0 percent of stipulated values. If proof testing cannot be verified, the links and/or rings shall be proof tested before being used to make a critical lift.

Figure 12-5. Rings and links.

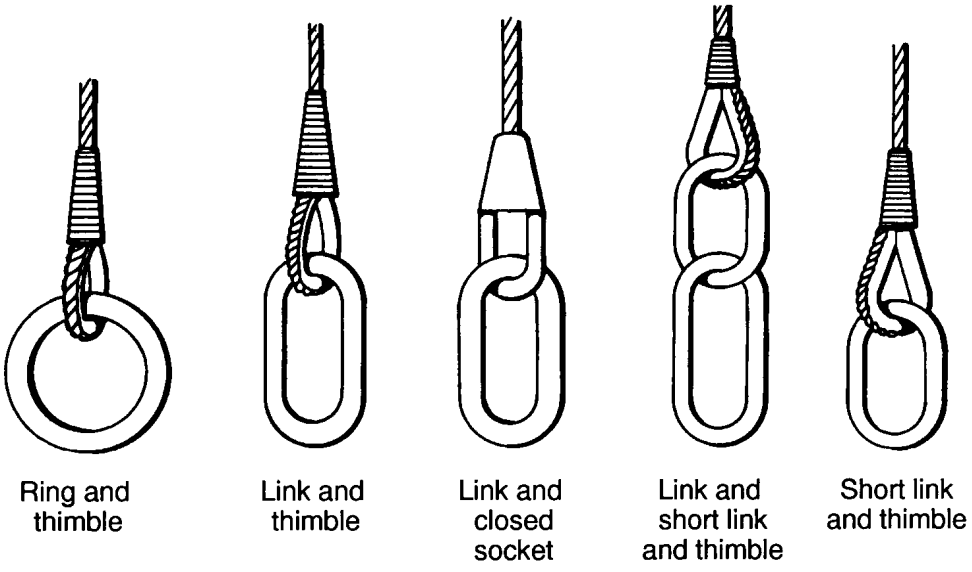


Table 12-4. Safe loads for weldless rings and links.

RINGS

Dimensions Diam., stock (in.)	Diam., inside (in.)	Est. wt., each (lb)	Safe load, single pull (lb)
7/8	4	2 3/4	7,200
7/8	5 1/2	3 1/2	5,600
1	4	3 5/8	10,800
1 1/8	6	6 1/2	10,400
1 1/4	5	7	17,000
1 3/8	6	10	19,000

SLING LINKS

Diam., stock (in.)	Length, inside (in.)	Inside width, small end	Inside width, large end	Est. wt. per 100 (lb)	Safe load, single pull (lb)
3/8	2 1/2	3/8	1 1/4	23	1,800
1/2	3	1/2	1 5/8	50	3,200
*5/8	3 3/4	1 1/4	2 1/2	110	4,200
*3/4	4 1/2	1 1/2	3	190	6,000
*7/8	5 1/4	1 3/4	3 1/2	285	8,300
*1	6	2	4	430	10,800
1 1/4	6	1 1/4	3 3/4	700	22,000
*1 3/8	8 1/4	2 3/4	5 1/2	1125	20,500

*Sizes of sling links denoted by the asterisk are new and have the larger inside dimensions needed for 2-leg slings.

END LINKS

Diam., stock (in.)	Inside length (in.)	Inside width (in.)	Est. wt. per 100 (lb)	Suggested safe loads (lb)
5/16	1 3/4	1/2	14	2,500
3/8	1 7/8	9/16	21	3,800
1/2	2 3/8	3/4	48	6,500
5/8	3 1/4	1	92	9,300
3/4	3 1/2	1 1/8	137	14,000
7/8	5 1/8	2	275	12,000
1	5 1/8	2	360	17,000
1 1/4	6 7/16	2 1/4	700	28,000
1 3/8	7 3/4	2 3/4	1000	30,000

12.7 SWIVEL HOIST RINGS

12.7.1 General

a. The following shall apply when using swivel hoist rings for hoisting:

1. They shall be fabricated from forged carbon or alloy steel.

2. Have a minimum design factor of 5:1.

3. The working load limit shall be forged, stamped, or inscribed into each swivel hoist ring by the manufacturer.

4. Permanently attached metal tag bearing the same information may also be used.

5. Have a class II fit and have a minimum thread engagement as recommended by the manufacturer.

6. When installed with a retention nut, follow the manufacturer recommendations.

b. The following shall apply to swivel hoist ring users:

1. Never use spacers between bushing flange and mounting surface.

2. Install hoist ring to recommended torque with a calibrated torque wrench making sure the bushing flange meets the load (work piece) surface.

3. Unless specific torque requirements are specified for the load (work piece) being lifted, the minimum recommended torque shall be as specified by the hoist ring manufacturer.

4. Maximum recommended torque requirements specified by the manufacturer should not be exceeded.

5. When load is applied to the hoist ring; there should be no interference between the load (work piece) and the hoisting ring (See Figure12-6).

6. The hoist ring should be able to swing or rotate freely under load (See Figure 12-6).

7. Attach lifting device ensuring free fit to the hoist ring bail (See Figure 12-6).

8. Carefully inspect each swivel hoist ring before use (See Figure 12-6). Visually inspect the hole to ensure that there has been no deformation.

9. Check the condition of the threads in the hole to ensure that the hoist ring will secure and the bushing can be brought down snug.

10. Destroy hoist rings that are cracked, bent, have damaged threads, or do not operate freely.

11. Permanently installed hoist rings shall be inspected before each use to ensure free movement of bail and swivel. Refer to specific requirements for load (work piece) with permanently installed hoist rings, before checking or re-torquing.

12.7.2 Critical Lifts

See Chapter 2, “Critical Lifts,” for critical lift requirements.

a. Swivel hoist rings used for critical-lift service shall have an initial proof load test of 200 percent of the rated capacity. Test weights shall be accurate to within -5 percent, +0 percent of stipulated values. If proof testing cannot be verified, the swivel hoist rings shall be proof tested before being used to make a critical lift.

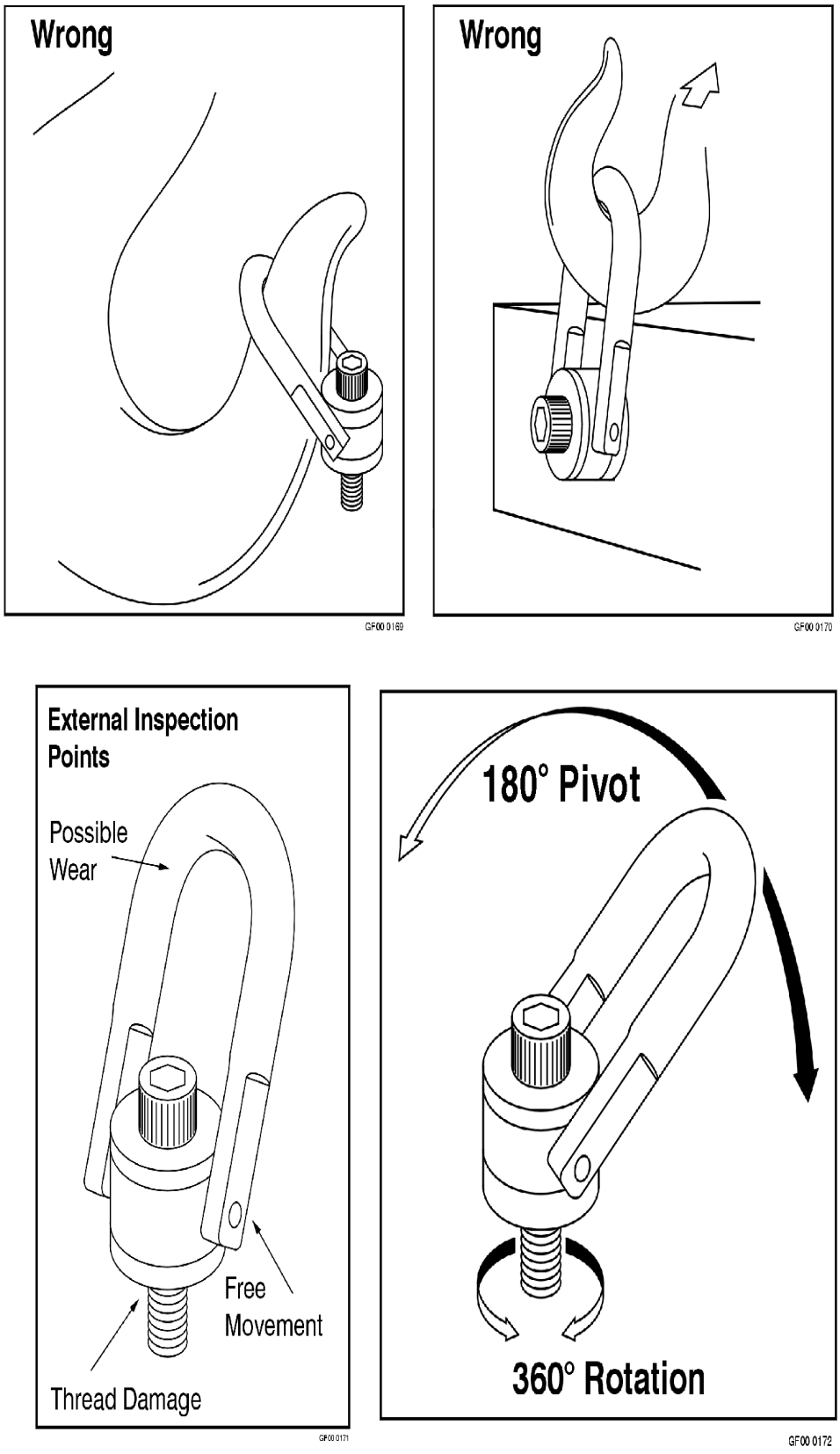


Figure. 12-6. Swivel Hoist Rings

12.8 LOAD-INDICATING DEVICES

a. Load-indicating devices are not required in routine operations where loads of known and essentially consistent weight are to be handled. Rather, load-indicating devices are required for use with loads of uncertain weight that could be within 90–100 percent of the rated capacity of the equipment or maximum working load of any part of the tackle. Use load-indicating devices where the equipment/ tackle configuration could result in binding or friction of the load that could cause a greater stress in the hoist or tackle than would result from the apparent hook load.

b. The accuracy of load-indicating devices shall depend on the requirements of the load system planned and shall not restrict the system requirements; an accuracy of 2 percent of full-scale reading within 10–70 percent of instrument range is recommended. The device should be selected so that the estimated hook load lies between 10 and 70 percent of the instrument range.

c. Dynamometers shall have a design factor of not less than 3:1.

12.9 PRECISION LOAD POSITIONERS

12.9.1 General

a. A precision load positioning device in the load path shall have a design factor of no less than 5:1, based on ultimate strength of the device's load bearing components.

b. A precision load positioner shall be operated, maintained, calibrated and tested in accordance with the manufacturer's instructions.

c. Prior to initial use, all new, repaired, and altered precision load positioning devices shall be load tested, and a written report shall be furnished, confirming the load rating. If the load test is not performed by the manufacturer, it shall be done under the direction of a designated or authorized person in strict compliance with the manufacturer's instructions. Special attention should be paid to the manufacturer's instructions concerning testing of devices equipped with load gages as they may be damaged during the load test.

12.9.2 Critical Lifts

See Chapter 2, "Critical Lifts," for critical lift requirements.

a. Precision load positioners used for critical-lift service shall have an initial proof load test confirming the load rating. If proof testing cannot be verified, the precision load positioners shall be proof tested before being used to make a critical lift.

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Exhibit I is intended to be a sample form only.
The equipment manufacturer's inspection/testing
criteria supercede any other criteria.
In cases where the equipment manufacturer does not include
inspection/testing criteria, other forms developed to facilitate
required inspection/testing are acceptable.

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EXHIBIT I
(SAMPLE FORM)

RIGGING ACCESSORIES LOAD TEST AND INSPECTION
(HOOKS, SHACKLES, RINGS, ETC.)

INSPECTOR _____ INSPECTION DATE _____

NOTES:

1. Proof test to 200% of rated capacity for critical lift service to certify new equipment procured without manufacturer's certification. Test loads shall be accurate to within -5%, +0% of the stipulated values.

_____ 2. Qualified inspector shall witness all steps below.

_____ 3. Accept/reject data should be to manufacturer's specifications. Hooks, shackles, rings, and the like, shall be removed from service and discarded if any of the following conditions are present that would cause doubt of the integrity of the accessories:

   A. Corrosion, damage, or undue wear

   B. Cracks, twists, or significant change in openings

      (1) 15% more than normal opening

      (2) 10% twist more than normal from the plane of the unbent hook

      (3) 10% wear

      (4) 5% elongation of the hook shank.

   C. Heat damage.

_____ 4. Shackles, rings, etc.

   A. Wear, corrosion, spreading, and deformation

      (1) 15% deformation of their new condition

      (2) Shackle pins—any sign of incipient failure in shear.

Type _____ Size _____ Rated Capacity (SWL) _____

Tested to _____

Serial Numbers _____ _____ _____ _____ _____ _____

Qualified inspector shall perform a nondestructive test by visual examination, liquid penetrant examination, or magnetic particle examination.
Acceptance: No cracks, linear indications, laps, or seams.

QUALIFIED INSPECTOR VERIFY _____ DATE _____

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CHAPTER 13
LOAD HOOKS

This chapter provides safety standards for the inspection, testing, and maintenance of load hooks installed on cranes or hoists and implements the requirements of ASME B30.10, Chapter 10-1, "Hooks." See Chapter 12, "Rigging Accessories," for rigging hook requirements.

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13.1 GENERAL

13.1.1 Marking

The manufacturer's identification shall be forged, cast, or die-stamped on a low-stress and nonwearing area of the hook.

13.1.2 Attachments

a. Hoisting hooks shall be fitted with a latch to bridge the throat opening to prevent the accidental release of slings or attachments. Hooks without latches may be used in special applications where the latch would interfere with the proper use of the hook, providing that (1) the use of the hook is restricted to the application for which it is approved, and (2) in questionable cases, concurrence is obtained from the appropriate safety organization.

b. If a handle or latch support whose design requires heat-treating is welded to the hook, welding shall be done prior to final heat-treating.

13.1.3 Load Limits

Hooks shall not be loaded beyond rated capacity except during load tests of the equipment of which they are a part.

13.1.4 Hook Standards

a. Hook design shall meet generally accepted hook design standards and be compatible with the requirements of ASME B30.10.

b. The hook material shall have sufficient ductility to permanently deform before failure at the ambient temperatures at which the hook will be used.

c. When a latch is provided, it shall be designed to retain such items as slings under slack conditions. The latch is not intended to support the load.

d. The bearing surfaces of new hooks shall be the arc of a circle. Gauge points, or hook gauges, for measuring spread after load testing should be provided.

e. Field-fabricated hooks shall meet the requirements of this section and shall be approved by the cognizant engineering and safety organizations.

13.2 INSPECTIONS

13.2.1 Hook Service

Hook service is defined as follows:

a. Normal service—operation at less than 85 percent of rated capacity except for isolated instances.

b. Heavy service—operation at 85 to 100 percent of rated capacity as a regular specified procedure.

c. Severe service—operation at heavy service coupled with abnormal operating conditions, (i.e., extreme temperatures, corrosive atmospheres, etc.)

13.2.2 Initial Inspection

a. Prior to initial use, all new and repaired hooks shall be inspected by a qualified inspector to ensure their compliance with the applicable provisions of ASME B30.10 Section 10-1.2. Dated and signed inspection records shall be kept on file and shall be readily available.

b. Inspection procedure and record keeping requirements for hooks in regular service shall be governed by requirements for the kind of equipment in which they are used. When such requirements are stated in standards for the specific equipment, they shall take precedence over the requirements of this section.

13.2.3 Daily Inspection

a. Operators or other designated personnel shall visually inspect hooks for deficiencies such as the following each day or prior to use if the hook has not been in regular service (records are not required):

1. Cracks, nicks, and gouges.

2. Deformation.

3. Damage from chemicals.

4. Latch engagement, damage to or malfunction of latch (if provided).

5. Evidence of heat damage.

b. A designated person shall examine deficiencies and determine whether they constitute a safety hazard and whether a more detailed inspection is required.

13.2.4 Frequent Inspection

a. Operators or other designated personnel shall visually inspect the hook at the following intervals (records are not required) :

1. Normal service—monthly. Operation at less than 85 percent of rated capacity except for isolated instances.

2. Heavy service—weekly to monthly. Operation at 85 to 100 percent of rated capacity as a regular specified procedure.

3. Severe service—daily to weekly. Operation at heavy service coupled with abnormal operating conditions, (i.e., extreme temperatures, corrosive atmospheres, etc.)

b. These inspections shall, in addition to the requirements of Section 13.2.3, “Daily Inspection,” include the following:

1. Wear.

2. Hook attachment and securing means.

c. A designated person shall examine deficiencies and determine whether they constitute a safety hazard and whether a more detailed inspection is required.

13.2.5 Periodic Inspection

a. A qualified inspector shall perform a complete inspection at the following intervals:

1. Normal service -- yearly.

2. Heavy service -- semiannually.

3. Severe service -- quarterly.

b. A designated person shall examine deficiencies and determine whether they constitute a safety hazard.

c. The inspection shall include the requirements of Section 13.2.4, "Frequent Inspection."

d. Hooks shall receive a nondestructive test (NDT) according to Section 13.4.1, "Nondestructive Testing."

e. Hooks having any of the following conditions shall be removed from service until repaired or replaced:

1. *Deformation*—Any bending or twisting exceeding 10° (or as recommended by the manufacturer) from the plane of the unbent hook.

2. *Throat opening*—Any distortion causing an increase in throat opening exceeding 15 percent (or as recommended by the manufacturer).

3. *Wear*—Any wear exceeding 10 percent (or as recommended by the manufacturer) of the original section dimension of the hook or its load pin.

4. Cracks.

5. If a latch is provided and it becomes inoperative because of wear or deformation or fails to fully bridge the throat opening, the hook shall be removed from service until the device has been repaired or replaced and the throat opening has been assessed as described above.

f. If hooks are painted, a visual inspection should take the coating into consideration. Surface variations can disclose evidence of heavy or severe service. The surface condition may call for stripping the paint in such instances.

g. Dated and signed inspection records shall be kept on file and shall be readily available.

h. A sample load test and inspection form is included as Exhibit I in Chapter 12, “Rigging Accessories.” This form is intended to be a sample only and is not intended to be mandatory.

13.3 TESTING

a. Each new or replacement hook of 150-ton capacity or greater and a prototype of each hook design of less than 150-ton capacity shall be proof-tested by the manufacturer in accordance with Table 13-1.

b. When proof tests are used, the hooks shall withstand the proof load application without permanent deformation when the load is applied for a minimum of 15 sec. This condition is considered satisfied if the permanent increase in the throat opening does not exceed 0.5 percent or 0.01 in. (0.25 mm), whichever is greater.

c. For a duplex (sister) hook having a pin eye, the proof load for the eye shall be in accordance with Table 13-1. The proof load shall be shared equally between the two prongs of a sister hook, unless the hook is designed for unbalanced loading.

d. Hooks that have been proof-tested shall be inspected by the magnetic-particle method in accordance with ASTM E-709 ("Standard Practice for Magnetic Particle Examination") and shall show no cracks, inclusions, or other relevant discrepancies; castings shall be evaluated in accordance with ASTM E-165 ("Standard Practice for Liquid Penetrant Inspection Method.")

e. No performance testing of hooks shall be required, except as is necessary to conform to the requirements for the equipment of which they are a part.

Table 13-1. Proof test load.

Rated load, tons (2,000 lb)	kg	% rated load	Proof load (minimum), tons (2,000 lb)	kg
0.50	453.6	200	1	907.2
1	907.2	200	2	1,814.4
5	4,536	200	10	9,072
10	9,072	200	20	18,144
15	13,608	200	30	27,216
20	18,144	200	40	36,288
25	22,680	200	50	45,360
30	27,216	200	60	54,432
35	31,752	200	70	63,504
40	36,288	200	80	72,576
45	40,824	200	90	81,648
50	45,360	200	100	90,720
60	54,432	193	116	105,235
75	68,040	183	137	124,286
100	90,720	166	166	150,595
125	113,400	150	188	170,554
150	136,080	133	200	181,440
175	158,760	133	233	211,378
200	181,440	133	266	241,315
250	226,800	133	333	302,098
300	272,160	133	399	361,973
350	317,520	133	465	421,848
400	362,880	133	532	482,630
450	408,240	133	598	542,506
500	453,600	133	665	603,288
Above 500	453,600	133		

Note: 1 ton (short, 2,000 lb) = 907.2 kg

For hooks with load ratings not shown above, use the next lower load rating for determining the percent of rated load to be applied.

13.4 NONDESTRUCTIVE TESTING (NDT)

13.4.1 NDT Requirements

a. For crane and hoist hooks of 10-ton rated capacity or greater that are assigned to heavy or severe service, a qualified inspector shall perform an nondestructive testing (NDT), at the following intervals:

1. Heavy service: annually.

2. Severe service: semiannually.

b. If detailed inspections are performed (refer to sections 13.2.3.b., 13.2.4.c., and 13.2.5.b.), the results shall be evaluated by a qualified person to determine the need for subsequent NDT. If NDT is deemed necessary, it shall be performed in accordance with Section 13.4.3.

13.4.2 NDT Records

Dated and signed NDT records, traceable to the hook by a serial number or other identifier, shall be kept on file as long as the hook remains in service and shall be readily available to appointed personnel.

13.4.3 NDT Methods

a. Use magnetic-particle testing or liquid-penetrant testing methods to inspect for surface intersecting discontinuities.

b. A qualified inspector or designated person shall perform NDTs in accordance with the following ASTM standards:

1. ASTM E-709.

2. ASTM E-165.

c. For magnetic-particle testing, a coil, yoke, or wet technique should be used to eliminate the possibility of prod burns or arc strikes.

d. Perform an NDT with the hook in place unless conditions indicate that disassembly for thread or shank inspection is necessary.

13.4.4 Acceptance Criteria

A designated person shall document and resolve the following relevant indications:

a. Arc strikes (welding or electrical).

b. Surface intersecting discontinuities 0.25 in. long or longer.

13.4.5 Discontinuity Removal

a. Two directions of discontinuity, “P” and “T,” are shown on Figures 13-1 and 13-2. Discontinuity “P” parallels the contour of the hook, is considered nonserious, and does not require removal. Discontinuity “T,” on the other hand, is transverse to the contour of the hook and is more serious; when occurring in zones B, C, or D, discontinuity “T” may reduce the longevity of the hook.

b. Discontinuities may be removed by grinding longitudinally following the contour of the hook to produce a smooth, gently undulating surface. In zones B and D, such grinding shall not reduce the original hook dimension by more than 10 percent. Such a reduction will not affect the working load limit rating or the ultimate load rating of the hook. In zone C, grinding shall not reduce the original dimension by more than 5 percent.

c. Under normal and proper application, zone A is an unstressed zone. Therefore, it is not required that discontinuities in that zone be ground out.

d. The hook shall be reexamined by performing an NDT after grinding to verify removal of relevant discontinuities.

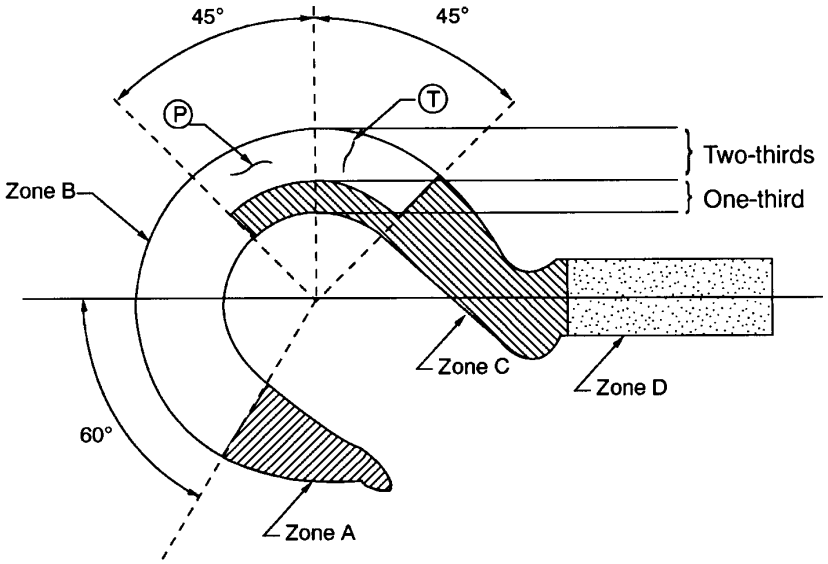

Figure 13-1. Shank hook.

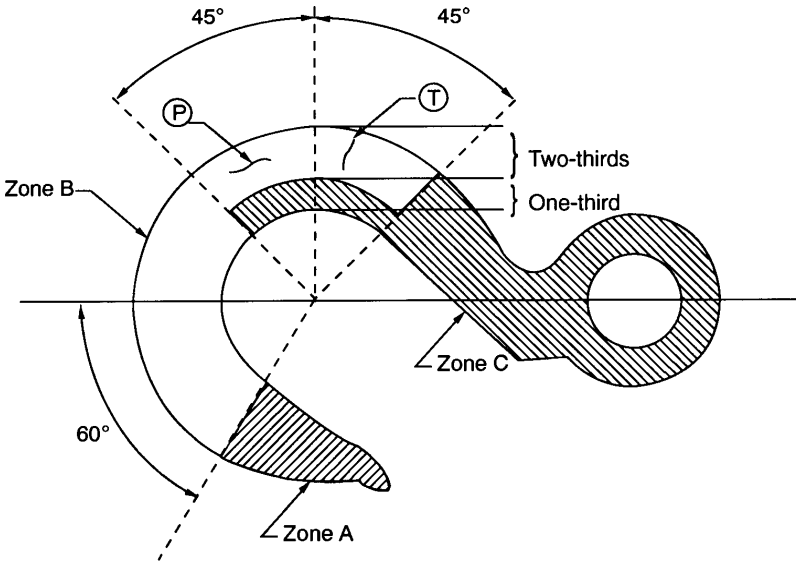

Figure 13-2. Eye hook.

13.5 MAINTENANCE

a. A hook latch that is inoperative or missing shall be replaced.

b. A hook with a latch that does not bridge the throat opening shall be removed from service until the latch is replaced or repaired and the hook is examined for deformation with special attention to the throat opening.

c. A designated person shall repair cracks, nicks, and gouges by grinding longitudinally, following the contour of the hook, provided no dimension is reduced more than 10 percent (or as recommended by the manufacturer) of its original value.

d. All other repairs shall be performed by the manufacturer or a qualified person.

13.6 OPERATION

Hook users shall do the following:

a. Determine that the weight of the load to be lifted does not exceed the load rating of the hook.

b. Avoid shock loading.

c. Center the load in the base (bowl or saddle) of the hook to prevent point loading of the hook.

d. Do not use hooks in such a manner as to place a side- or backload on the hook.

e. When using a device to bridge the throat opening of the hook, ensure that no portion of the load is carried by the bridging device.

f. Keep hands and fingers from between the hook and the load.

g. Load duplex (sister) hooks equally on both sides, unless the hook is specifically designed for single loading.

h. Do not load the pinhole in duplex (sister) hooks beyond the rated load of the hook.

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Exhibit I is intended to be a sample form only.
The equipment manufacturer's inspection/testing
criteria supercede any other criteria.
In cases where the equipment manufacturer does not include
inspection/testing criteria, other forms developed to facilitate
required inspection/testing are acceptable.

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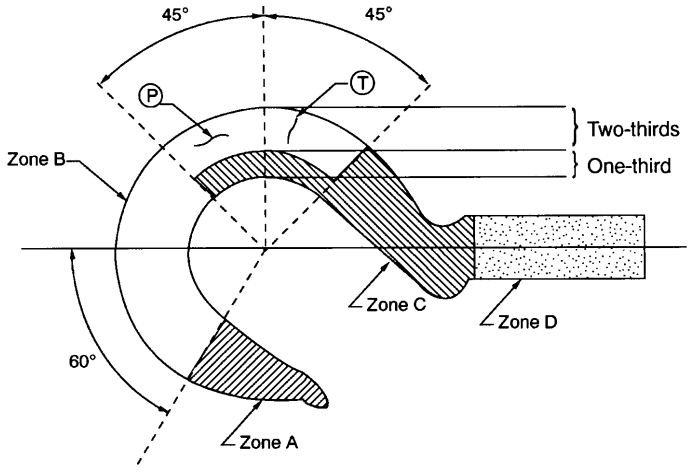
EXHIBIT I
(SAMPLE FORM)

DEVICE:_____ DEVICE NO:_____

SERVICE CLASSIFICATION:_____ LOCATION:_____



Two directions of discontinuities are labeled on the drawing above as "P" and "T." Discontinuity P parallels the contour of the hook and is considered non-serious in nature and does not require removal from service. Discontinuity T is transverse to contour of the hook and is more serious in nature. Discontinuity T, when occurring in Zones B, C, or D, may reduce longevity of the hook. If the inspection identifies discontinuities, NDT should be considered.

	Original Measurements				
Date					
Throat Opening					
Tram AA					
Tram BB					
Twist Angle					
Crack					
Wear					
Hook Latch					
NDT Performed					
Pass/Fail					
Inspector					

COMMENTS:

NOTES ON RESULTS:

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